

1 **Listing of the Claims**

2 1. (Previously Presented) A method for simulating a real-time rendering of a desired
3 graphical effect in an image of an object on a display, in regard to a single static viewpoint,
4 comprising the steps of:

5 (a) precomputing data defining a behavior of light rays illuminating the object in
6 regard to the single static viewpoint, based on a plurality of input images, to produce a plurality of
7 morph maps for the object in which at least one set of pixel-dependent data is associated with each
8 pixel position on the display;

9 (b) in response to one of a user action and an event that indicates the desired
10 graphical effect, performing a transformation two-dimensionally using the plurality of morph maps to
11 produce an output image that simulates the real-time rendering of the desired graphical effect; and

12 (c) displaying the output image.

13 2. (Original) The method of Claim 1, wherein the step of precomputing comprises the step of
14 producing data that include a blending factor.

15 3. (Original) The method of Claim 1, wherein the step of precomputing comprises the step of
16 producing data that include an additive factor that is used to control saturation of the output image.

17 4. (Original) The method of Claim 1, wherein the step of precomputing comprises the step of
18 tracing rays of light to determine the plurality of morph maps based on a global illumination and a
19 local illumination at each intersection of the rays of light with a surface.

20 5. (Original) The method of Claim 1, wherein the step of performing the transformation
21 comprises the steps of:

22 (a) producing a plurality of warped images from the plurality of morph maps; and

23 (b) combining the plurality of warped images over a range, with a cross-dissolve, to
24 produce successive output images in which the object morphs between an initial state and a final state.

25 6. (Original) The method of Claim 1, wherein the step of performing the transformation
26 comprises the step of mapping a selected portion of a surface of the object onto a different part of the
27 object to simulate an effect corresponding to movement of the selected portion of the surface over the
28 object.

29 7. (Original) The method of Claim 6, wherein only pixels of the object that have been altered
30 during the transformation to implement the effect are recomputed in the output image.

1 8. (Original) The method of Claim 6, wherein the step of performing the transformation
2 comprises the steps of:

3 (a) providing a grid of cells that overlies and bounds pixels in the selected portion
4 of the surface of the object in the output image;

5 (b) for each cell of the grid, associating an arbitrary rectangle having an area that
6 bounds all samples in an original image affected by the pixels in the cell of the output image; and

7 (c) determining a union of all rectangles that are associated with the cells of the
8 grid that intersect the area of the arbitrary rectangle, to produce the output image.

9 9. (Original) The method of Claim 8, further comprising the step of using an index to map
10 between a region in an input image and a corresponding region in the output image, to determine
11 which portion of one of the input image and the output image is changed if a portion of the other of
12 the input image and the output image has changed.

13 10. (Original) The method of Claim 1, wherein the transformation to achieve the desired
14 effect comprises one of the steps of:

15 (a) mapping a texture onto the object in the output image;

16 (b) applying a reflection to the object in the output image; and

17 (c) applying a refraction of the object in the output image.

18 11. (Original) The method of Claim 1, wherein the step of precomputing includes the step of
19 storing anti-aliasing data for use in producing the output image.

20 12. (Original) The method of Claim 1, wherein the step of precomputing is based on one of a
21 three-dimensional geometry of the input images and a set of properties of a material in the input
22 images.

23 13. (Original) The method of Claim 1, wherein the data produced in the step of
24 precomputing includes a lookup table in which parameters used in producing the output image are
25 stored.

26 14. (Original) A computer-readable medium having computer-executable instructions for
27 performing the steps recited in Claim 1.

28 15. (Original) A computer-readable medium having computer-executable instructions for
29 performing steps (b) and (c) in Claim 1.

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1 16. (Previously Presented) A method for simulating rendering of graphical effects in an
2 image displayed in real time, comprising the steps of:

3 (a) precomputing a plurality of morph maps of a displayed scene in regard to a
4 single static viewpoint, said plurality of morph maps being blendable and including anti-aliasing
5 information and data for each of a plurality of pixels in a defined area;

6 (b) storing the morph maps for subsequent use in simulating rendering of a
7 selected effect associated with the defined area;

8 (c) transforming at least one input image two-dimensionally using a blending of
9 the plurality of morph maps to produce the selected effect in an output image; and

10 (d) displaying the output image, simulating the real-time rendering of the selected
11 effect in the output image.

12 17. (Original) The method of Claim 16, wherein the selected effect comprises at least one of
13 the steps of:

14 (a) anti-aliasing to smooth edges in the output image;

15 (b) displaying light refraction in the output image;

16 (c) displaying light reflection in the output image;

17 (d) morphing between an object in the displayed scene and a substantially altered
18 object in a final output image over a defined range of intermediate images, starting with the input
19 image; and

20 (e) dynamically warping a selected portion of an object over a different portion of
21 an object in the output image.

22 18. (Original) The method of Claim 16, wherein for each pixel in the defined area, the data
23 comprising each of the plurality of morph maps includes at least a subset of the following parameters:

24 (a) an index that identifies a pixel data set from among a plurality of pixel data
25 sets in the morph map;

26 (b) an image identifier that, as a function of its value, indicates one of:

27 (i) the input image from among a plurality of input images, in which the
28 defined area appears; and

29 (ii) a constant color that is to be applied to the pixel;

30 (c) coordinates of the pixel in the input image;

1 (d) the constant color that is to be applied to the pixel, dependent upon the value of
2 the image identifier;

3 (e) a multiplicative coeponent applied to modulate an appearance of the pixel;

4 (f) an additive factor used to shift the appearance of the pixel with a color
5 saturation; and

6 (g) a blending factor applicable to the additive factor.

7 19. (Original) The method of Claim 16, wherein the step of precomputing comprises the step
8 of computing the plurality of morph maps with a light simulating algorithm that determines a local
9 illumination and a global illumination at each point where a light ray intersects a surface in the input
10 image.

11 20. (Original) The method of Claim 16, wherein the effect comprises the rendering of a
12 textured patch on a surface of an object as the patch is dragged over the surface by a user, further
13 comprising the step of indexing pixels on the input image to corresponding pixels in the output image
14 in which the patch is illustrated as it is dragged.

15 21. (Original) The method of Claim 16, wherein the effect comprises the rendering of an
16 object simulating a refraction that occurs as light reflected from the object passes through a
17 non-homogeneous medium that is at least partially transparent.

18 22. (Original) The method of Claim 16, wherein only pixels in the input image that have
19 changed are transformed to produce the output image.

20 23. (Original) The method of Claim 22, further comprising the step of bi-directionally
21 mapping between each of a plurality of pixels in a selected region of the input image and a
22 corresponding pixel in a corresponding region of the output image, to define the pixels that have
23 changed in the input image when producing the output image.

24 24. (Previously Presented) A system for simulating a real-time rendering of a desired
25 graphical effect in an image of an object on a display in regard to a specific viewpoint that remains
26 static, comprising:

27 (a) a display on which images are displayable;

28 (b) a memory in which a plurality of machine instruction are stored; and

29 (c) a processor coupled to the display and to the memory, said processor executing
30 the plurality of machine instructions to carry out a plurality of functions, including:

1 (i) precomputing data defining a behavior of light rays illuminating the
2 object based on a plurality of input images, producing a plurality of morph maps in which at least one
3 set of pixel-dependent data is associated with each pixel position, said data including anti-aliasing
4 information, said plurality of morph maps being stored in the memory;

5 (ii) in response to one of a user action and an event that indicates the
6 desired graphical effect, performing a transformation two-dimensionally using the plurality of morph
7 maps to produce an output image that simulates the real-time rendering of the desired graphical
8 effect; and

9 (iii) displaying the output image on the display.

10 25. (Original) The system of Claim 24, wherein the data produced by precomputing include
11 a blending factor.

12 26. (Original) The system of Claim 24, wherein the data produced by precomputing include
13 an additive factor that is used to control a color saturation in the output image.

14 27. (Original) The system of Claim 24, wherein when precomputing, the processor traces
15 rays of light to determine the plurality of morph maps based on a global illumination and a local
16 illumination at each intersection of the rays of light with a surface in at least one of the input images.

17 28. (Original) The system of Claim 24, wherein when performing the transformation, the
18 processor:

19 (a) produces a plurality of warped images from the plurality of morph maps; and

20 (b) combines the plurality of warped images with a cross-dissolve over a range to
21 produce successive output images in which the object morphs between an initial state and a final
22 state.

23 29. (Original) The system of Claim 24, wherein when performing the transformation, the
24 processor maps a selected portion of a surface of the object onto a different part of the object to
25 simulate an effect corresponding to movement of the selected portion of the surface over the object.

26 30. (Original) The system of Claim 29, wherein only pixels of the object that have been
27 altered are recomputed by the processor in the output image.

28 31. (Original) The system of Claim 29, wherein when performing the transformation, the
29 processor:

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1 (a) provides a grid of cells that overlies and bounds pixels in the selected portion
2 of the surface of the object in the output image;

3 (b) for each cell of the grid, associates an arbitrary rectangle having an area that
4 bounds all samples in an original image affected by the pixels in the cell of the output image; and

5 (c) determines a union of all rectangles that are associated with the cells of the
6 grid that intersect the area of the arbitrary rectangle, to produce the output image.

7 32. (Original) The system of Claim 31, wherein execution of the machine instructions causes
8 the processor to produce an index to map between a region in an input image and a corresponding
9 region in the output image, said index being used by the processor to determine which portion of one
10 of the input image and the output image should be changed if a portion of the other of the input image
11 and output image has changed.

12 33. (Original) The system of Claim 24, wherein the transformation to achieve the desired
13 effect comprises one of:

14 (a) mapping a texture onto the object in the output image;

15 (b) applying a reflection to the object in the output image; and

16 (c) applying a refraction of the object in the output image.

17 34. (Original) The system of Claim 24, wherein when precomputing, the processor stores
18 anti-aliasing data in the memory for use in producing the output image.

19 35. (Original) The system of Claim 24, wherein the precomputing employs at least one of a
20 three-dimensional geometry of the input images, and a set of properties of a material in the input
21 images.

22 36. (Original) The system of Claim 24, wherein the data produced when precomputing
23 includes a lookup table in which parameters used in producing the output image are stored in the
24 memory.

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